MTCA Science Advisory Board Meeting Summary

June 22, 2004
9:00 am – 3:30 pm

EPA Region X
1200 6th Avenue
Pend-Oreille Room
Seattle WA

Key Agenda Items: Defining Moderate Levels of Lead in Soils, presenting overview of pending discussions on Defining Moderate Levels of Arsenic in Soils and the MTCA Natural Attenuation Guidance.

Agenda Items:

Introductory Remarks

Discussion: Defining Moderate Levels – Lead

Public Comment

Overview – Defining Moderate Levels – Arsenic

Overview – Natural Attenuation Guidance

Public Comment

Next Steps

Attendees:

SAB Members: Dr. Hank Landau; Dr. Bruce Duncan; Dr. Marjorie Norman; Dr. Elaine Faustman (unable to attend).

Agency Staff: Dave Bradley; Curtis Dahlgren; Michael Feldcamp; Dawn Hooper; Hun Seak Park.

Public: Greg Glass; Paul Agid; Karen Pickett; Jim W. White; Greg Wingard; Scott Hooton.

Introductory Remarks and Review of May 28th Meeting Summary

The SAB reviewed the draft May 28, 2004 SAB meeting summary. The Board asked that the summary be modified to reflect that some members of the SAB suggested (rather than recommended) that Ecology should consider dividing the moderate lead range into two portions. Prior to finalizing the meeting summary, Board members asked that Ecology confer with Dr. Faustman to determine whether she has identified additional changes or clarifications. Ecology reviewed the results of the SAB meeting with Dr. Faustman and incorporated her comments to this summary.

Dr. Landau, in his opening remarks, suggested that Ecology should determine whether the recommendations developed by the SAB are consistent with the recommendations of the Area-wide Task Force.

Defining Moderate Levels of Lead in Soils – Dave Bradley

Additional Discussion Materials: Dave Bradley presented the SAB with information on measures to reduce exposure to lead-contaminated soils. The information materials were focused on the three main pathways of lead exposure identified at the May 28th Board meeting (i.e. Incidental ingestion of soil and dust, consumption of homegrown vegetables and inhalation of re-suspended soils and dust). The materials were designed to provide a general sense of the relative contribution of each of the pathways and the effectiveness of various intervention measures.

General Discussion: The Board began the morning's discussion by reviewing the assumptions and policy choices that underlie the Areawide Soil Contamination Task Force's recommendations and Ecology's working definition for lead-contaminated soils. The Board periodically revisited these assumptions and choices during the morning as they discussed the individual questions identified by Ecology. Key points that emerged from those discussions include the following:

- Key assumptions: There are several key assumptions that underlie the approach for addressing lead-contaminated soils: (1) children are the population group with the greatest susceptibility and exposure to lead; (2) scientists are currently unable to identify a threshold for lead toxicity in children and even if such a threshold could be identified for an individual child, it would be difficult to extrapolate such a finding to other children; (3) given current scientific information on the effects of low-level lead exposure, it is prudent to take reasonable steps to prevent exposure; (4) responses will vary depending on the exposure situation (e.g. schools) and soil lead concentrations; (5) responses will occur over an extended period of time.

- Policy Framework and Choices: The Task Force recommendations define a strategy where different approaches would be used to address soils with low, moderate and high lead concentrations:

    - "Low" Concentrations of Lead in Soils: The Task Force recommended that no further action be required or recommended at properties where soil concentrations are below the MTCA Method A Cleanup Level (250 mg/kg). The key risk management or policy choice underlying the MTCA Method A Cleanup Level is the choice of the target blood lead concentration. The Method A Cleanup Level is established at a soil concentration that is unlikely to result in child blood lead concentrations above 10 ug/dL.

- "Moderate" Concentrations of Lead in Soils: The Task Force recommended that people and organizations be encouraged to (1) implement initial measures (e.g. soil covers, behavior changes) to reduce contact with such soils and (2) implement more permanent measures to prevent contact as property is developed or redeveloped. Ecology's working definition for "moderate" levels of lead are bounded by the MTCA cleanup level (250 mg/kg) and a soil concentration that is considered unlikely to result in child blood lead concentrations above 15 ug/dL.

- "High" Concentrations of Lead in Soils: The Task Force recommended that Ecology provide more formal review and oversight of cleanup measures for properties with high lead concentrations. Ecology's working definition for "high" concentrations of lead in soils includes soils that have concentrations that exceed the upper end of the moderate range (i.e. soil concentrations where there is a reasonable likelihood that soil exposure might result in child blood lead concentrations above 15 ug/dL). Although Ecology anticipates that the measures for dealing with high concentrations will be similar to the measures for properties with moderate concentrations (e.g. containment), responses for properties differ in terms of (1) the degree of oversight under MTCA or other regulatory processes, (2) priority for cleanup funds; (3) cleanup timeframes and (4) reporting requirements.

Dr. Duncan observed that Ecology doesn't seem to quantify the time but to recognize that given that vast number of individual properties actions will occur over the long term. He also wondered what the residual level in soils would be after recommended actions were (eventually) taken for elevated levels in the 'moderate' range.

Discussion Questions: Prior to the meeting, Ecology distributed a list of six remaining questions related to Ecology's definition of moderate levels of lead-contaminated soils. The remaining questions focused on the key issues that have emerged from earlier SAB discussions. The Board spent the rest of the morning discussing those questions. The results of those discussions and the Board's preliminary recommendations are summarized in the following paragraphs.

1. **Question**: Does the Science Advisory Board agree that the methods and assumptions used by Ecology to define the upper end of the moderate range are scientifically defensible?

Ecology proposed a series of soil concentrations for use in defining the upper end of the moderate range that vary depending on whether a property is used as a residence (500 mg/kg), school/child care facility/park (700 mg/kg) or a commercial facility (1000 mg/kg). The technical and policy rationale for selecting these concentrations includes the following: (1) Ecology's current policy is to define the upper end of the moderate soil concentration range at a level where it is unlikely (< 1-5%) that exposure will result in blood lead levels > 15 ug/dL; (2)

Ecology believes that the IEUBK model is a sound method for identifying soil lead concentrations that are unlikely to result in blood lead concentrations > 15 ug/dL; and (3) Ecology believes that the methods and assumptions incorporated into the IEUBK model generally reflect a health protective approach for dealing with uncertainty and variability.

The Board reviewed this question in light of the results of previous SAB meetings. Specifically:

- Use of the IEUBK Model and Exposure Assumptions: The Board noted they had previously concluded that (1) the IEUBK model was a sound approach for evaluating exposure to lead-contaminated soils and (2) the individual parameters and assumptions used by Ecology to estimate exposure are generally consistent with current EPA guidance materials.

- Policy Choice on Blood Lead Concentration Used to Establish Upper End of the Moderate Range: The Board observed that the choice of the soil concentration used to define the upper end of the moderate range is driven by the choice of what constitutes a "high" blood lead concentration. The Board acknowledged this was largely a policy choice. However, the Board noted (1) there is a general scientific consensus around the conclusion that blood lead concentrations of > 15 ug/dL are harmful to children's health and (2) Ecology's use of this value (15 ug/dL) as the basis for defining the upper end of the moderate range is consistent with the policy choices inherent in the current CDC guidelines.

- Using the Upper End of the Moderate Range to Identify the Need for Different Types of Responses: The Board suggested that the soil concentration used to distinguish between high and moderate should reflect the fact that different responses are being implemented in the two categories. After discussing this issue, the Board stated that it appears that people are being encouraged or required to implement similar types of physical measures (i.e. containment) at both moderate and high concentrations. However, the Board also recognized that the overall strategy envisions different processes being used to implement those physical responses. Specifically, Dr. Norman concluded that the primary differences seem to revolve around the level of guidance and oversight (i.e. greater oversight and/or reliance on the traditional MTCA process for properties found to have high lead concentrations).

The Board agreed that the methods and assumptions used by Ecology to define the upper end of the moderate range are scientifically defensible. Given the rapidly evolving body of scientific information on the relationships between lead exposure and adverse health effects, they also recommended that Ecology periodically review this level and recommended actions.

2. **Question**: Does the Science Advisory Board agree that the methods and assumptions used by Ecology to define the lower end of the moderate range are scientifically defensible?

Ecology proposed to use the current MTCA Method A soil cleanup level (250 mg/kg) identify the lower end of the moderate range. The technical and policy rationale for selecting this concentration to define the lower end of the moderate range includes the following: (1) Ecology's current policy is to not require further actions under the MTCA to address human health risks where soil levels are less than 250 mg/kg (Method A Soil Cleanup Level) which represents a soil concentration that is unlikely (< 1-5%) to result in blood lead levels above 10 ug/dL; (2) Although recent studies indicate that child may be adversely affected by lead exposures at blood lead concentrations < 10 ug/dL, the CDC has decided not to lower their level of concern; (3) Ecology believes that the IEUBK model is a sound method for identifying soil lead concentrations that are unlikely to result in blood lead concentrations > 10 ug/dL; and (4) Ecology believes that the methods and assumptions incorporated into the IEUBK model generally reflect a health protective approach for dealing with uncertainty and variability.

The Board reviewed this question in light of the results of previous SAB meetings. Specifically:

- Use of the IEUBK Model and Exposure Assumptions: The Board noted they had previously concluded that (1) the IEUBK model was a sound approach for evaluating exposure to lead-contaminated soils and (2) the individual parameters and assumptions used by Ecology to estimate exposure are generally consistent with current EPA guidance materials.

- Policy Choice on Blood Lead Concentration Used to Establish Lower End of the Moderate Range: The Board observed that the choice of the soil concentration used to define the lower end of the moderate range is driven by the choice of what constitutes a blood lead concentration that requires no further action. The Board acknowledged this was largely a policy choice. However, the Board noted there is an emerging scientific consensus around the conclusion that blood lead concentrations of < 10 ug/dL can be harmful to children's health. Consequently, the Board expressed some reservations associated with using the MTCA cleanup level (which is based on a blood lead concentration of 10 ug/dL) to distinguish between soils requiring some type of action and soils that require no further action. Dr. Landau suggested that there may be a need for actions to reduce exposure to lead-contaminated soils even where the soil concentrations are unlikely to result in blood lead concentrations above 10 ug/dL. The Board identified two main options for addressing this concern: (1) expand the education and awareness campaign to include information and education materials on ways to reduce exposure to soil concentrations below 250 mg/kg (See discussion question #3) and (2) establish a lower bound for the moderate range. With respect to the later

approach, the Board noted this might be accomplished by dividing the moderate range into two categories that correspond to blood lead concentrations of 5-10 ug/dL and 10-15 ug/dL.

- Incremental Impact on Blood Lead Concentrations Resulting from Soil-Related Lead Exposure: At the May 28th Board meeting, the Board recommended that Ecology evaluate the incremental exposure resulting from lead-contaminated soils. They recommended that Ecology consider soil-only impacts on blood lead concentrations when specifying low, moderate and high soil concentrations (as opposed to considering lead exposure from all sources). Ecology provided the Board with preliminary estimates of soil-related (incremental) impacts on blood lead concentrations. Those initial calculations suggest that a soil concentration of 250 mg/kg is associated with a soil-related change in blood lead concentrations of 4.5 – 5.8 ug/dL.

- Comment, post meeting, from Dr. Faustman: Given the variability of risk across the low/moderate range, Ecology should tailor a range of materials and approaches that reflects the increasing level of risk as soil levels increase. The objective in the low range would be to increase awareness. Additionally, attention should be paid to areas of high density of former orchard areas and to real estate transactions. The term "moderate" should be more accurately replaced with the term "intermediate".

The Board agreed that the methods and assumptions used by Ecology to define the lower end of the moderate range are scientifically defensible. However, the Board also noted there is an emerging scientific consensus that blood lead concentrations of < 10 ug/dL can potentially be levels of concern with respect to children's health. The Board also agreed that available scientific information does not permit the identification of safe or threshold concentration below which there are no health risks. Consequently, the Board also recommended that Ecology review whether the underlying basis for the current MTCA cleanup level (e.g. 10 ug/dL defines a level where no further action is required under MTCA) remains consistent with the MTCA statutory directives.

3. **Question**: Does the Science Advisory Board believe there is a sound scientific justification for providing information on ways to reduce lead exposure in situations where soil concentrations are below the MTCA cleanup level (i.e. < 250 mg/kg)?

As noted above, the Science Advisory Board has expressed concerns about Ecology's use of a blood lead concentration of 10 ug/dL to distinguish between properties that require some type of action and properties that require no further action. The primary bases for this concern are (1) the results from several studies where adverse health effects have been reported at blood lead concentrations < 10 ug/dL and (2) the conclusions reached in a soon-to-be published scientific review prepared by a work group of the Advisory Committee

on Childhood Lead Poisoning Prevention (ACCLPP), The Board suggested that one approach for addressing this concern would be to provide information on exposure reduction measures to owners/residents in areas where soil concentrations are less than 250 mg/kg.

At the May 28th meeting, the Board and members of the audience identified several scientific, policy and feasibility considerations that argue for providing information on exposure reduction measures where soil concentrations are below 250 mg/kg. These include: (1) Recent studies indicate that children may be adversely affected where exposure levels result in blood lead concentrations < 10 ug/dL. Available scientific evidence does not provide a sufficient basis for identifying a threshold below which adverse health effects are not expected; (2) CDC has concluded there are no effective clinical interventions that are known to lower blood levels for children with blood lead concentrations < 10 ug/dL. The lack of effective intervention measures emphasizes the importance of primary prevention measures; (3) People can implement measures to prevent exposure to elevated levels of lead in soils. However, awareness and information are necessary prerequisites for taking such steps.

The Board discussed the need for balancing the cost of providing preventative information at levels below 250 mg/kg vs. targeting an approach that addresses higher levels of contaminants as well as a balanced approach to addressing elevated levels at existing developments vs. targeting new construction on previously undeveloped lands.

Dr. Landau expressed an opinion that expanding the education and awareness building effort would not significantly increase program costs because the agencies were already providing information materials. Given the information on health effects below 10 ug/dL and the lack of effective clinical interventions, he expressed his opinion that it is appropriate to expand current awareness-building efforts because many people are unaware of the potential health risks and steps they can take to reduce exposure.

Post meeting note from Dr. Faustman: Ecology and the Department of Health should review the scientific basis for the approaches to risk communication and behavioral intervention. Actions at levels below 250 mg/kg should include individual and community level approaches to reducing potential exposure. She also suggested that the SAB consider recommending that Ecology define a lower limit on soil lead concentrations (such as 100mg/kg) so that is clear that actions are not needed at levels nearer to 0 mg/kg.

The Science Advisory Board agreed that there is a sound scientific justification for providing information on ways to reduce lead exposure in situations where soil concentrations are below the MTCA cleanup level (i.e. < 250 mg/kg) This is consistent with the evolving body of scientific information that suggests that blood lead concentrations of < 10 ug/dL can potentially be levels of concern to children's health. The Board believes

this recommendation is consistent with the health-based tiered risk management approach recommended by the Area-wide Soil Contamination Task Force. They recommended that Ecology modify existing materials and information campaigns to incorporate such materials.

4. **Question**: Does the Science Advisory Board agree that it is scientifically defensible to conclude that levels protective of young children also protect older children and adults?

One of the assumptions underlying Ecology's working definition for moderate levels of lead in soils is that levels that are protective of young children also protect older children and adults. Ecology's rationale for this assumption include: (1) Studies indicate that younger children (less than 36 months) are more susceptible than older children and adults due to differences in exposure, biokinetics and neurological development; (2) Soil concentrations identified using EPA Adult Lead Model are based on neurological effects in the developing fetus and are considered to be protective for other types of health effects in adults (e.g. hypertension); and (3) Health risks associated with adult exposures are generally lower than estimated health risks associated with child exposures.

The Board discussed whether levels protective of young children would also be protective of older children and adults, considering both the range covered through the IEUBK model and older kids. The Board is concerned about work place exposure or exposure through intensive gardening and requests additional information about exposures to these populations. Rick Roeder mentioned that is rare for children to be in orchards and that a more likely farm worker-child exposure pathway would be through the home environment. Rick mentioned that existing educational materials exist through the agricultural licensing program and are intended to dissuade the presence of children in orchards.

The Science Advisory Board agreed that it is scientifically defensible to conclude that levels protective of young children, on the average, also protect older children and adults (including sensitive adult populations (such as menopausal women) who may remobilize lead stored in bones.

5. **Question**: Does the Science Advisory Board agree that it is scientifically defensible to conclude that surface soil lead concentrations below 1000 mg/kg are unlikely to significantly impact ground water?

Ecology postponed discussion of question regarding groundwater impacts to the next meeting. Hank noted that it is particularly important for areas in western Washington where smelter impacts exist. Ecology is working to compile the requested information regarding whether there are situations where impact to groundwater exists. Dr. Duncan offered to check with people at EPA about whether there are areas where the combined effects of lead and arsenic in the environment are additive. He also noted that it is important to be aware of the

differences between eastern and western Washington in terms of impacts from lead and arsenic.

6. **Question**: Given available information, where does the SAB recommend that Ecology focus future information collection and review?

The Board reviewed and briefly discussed the list of future information collection options compiled by one or more SAB members during previous Board discussions. The list and SAB comments on individual items are summarized below:

- Collect and evaluate information on the variability in blood lead concentration in Washington children and the various risk factors that influence blood lead concentrations. The Board noted that current blood lead sampling is based on non-random sampling which prevents meaningful extrapolation to the general population.

- Collect and evaluate information on soil lead concentrations in Washington in order to better characterize the variability in lead concentrations and use that information when designing property-specific sampling efforts. The Board noted that it would be important to identify factors that influence variability.

- Collect and evaluate existing information on lead concentrations in vegetables grown in Washington. Especially regarding locally grown commercial crops located in area-wide contamination zones. A national value may not be appropriate for such crops.

- Collect and evaluate information on the relationship between soil pH levels and other factors that might influence the potential for lead in surface soils to migrate into underlying groundwater aquifers.

- Periodically review, evaluate and, as appropriate, revise the Method A soil cleanup level for lead based on scientific information on adverse health effects at blood lead concentrations below 10 ug/dL.

- Establishing moderate levels for ecological terrestrial health. Dr. Duncan noted that outcome of the eventual SAB discussion about establishing moderate levels may point to additional data needs.

- Collect and evaluate information on soil lead concentrations along roads in Washington.

The Board concluded that the list appears reasonable. The SAB believes there are several areas where additional scientific information is needed. Knowledge about these areas will contribute to the ability to reduce the risk

of exposure to area-wide soil contamination. They expressed a willingness to discuss this further as Ecology developed specific data collection plans.

Introduction: Defining Moderate Levels of Arsenic

Dave Bradley presented an overview of several questions that Ecology is asking the SAB to consider as part of in determining whether the proposed range of moderate level of arsenic in soil is scientifically defensible. The Board briefly discussed several issues that will be pertinent when the Board reviews the questions posed by Ecology. These include: (1) the range of HQ values considered by Ecology when developing the working definition for moderate levels of arsenic in soils; (2) the uncertainty factors used to establish the reference doses for chronic and less-than lifetime exposures; (3) potential differences in toxicity for trivalent and pentavalent forms of arsenic; and (4) the potential for additive, synergistic or antagonistic interactions with other contaminants.

Natural Attenuation Guidance

Over the past few years, natural attenuation in the remediation of contaminated ground water has drawn a tremendous amount of interest from both technical and regulatory perspectives due to the perception of significant cost savings under certain favorable conditions. In response, many technical documents on this subject have been published.

As part of the amendment of the MTCA Cleanup Regulation on February 12, 2001, Ecology set forth expectations in WAC 173-340-370(7) regarding when natural attenuation may be appropriate as part of a cleanup action. During the rule-making process, Ecology committed to providing additional guidance on the appropriate use of natural attenuation as a cleanup action under MTCA and on how to evaluate the feasibility and performance of natural attenuation as a cleanup action for ground water contaminated with petroleum hydrocarbons. As with any other cleanup action alternative, a cleanup action that uses natural attenuation, either alone or in conjunction with other cleanup action components, must achieve cleanup standards within a reasonable restoration time frame and meet the other minimum requirements for cleanup actions set forth in WAC 173-340-360. The guidance clarifies these regulatory requirements and provides the user with the means to determine compliance with those requirements. Ecology is requesting the Board's review of the technical aspects of the guidance.

1. Presentation of General Guidance

Hun Seak Park provided a brief summary on the following aspects of Natural Attenuation guidance:

- The reasons why Natural attenuation has been considered;
- The core publications used to develop the natural attenuation guidance;

- US-EPA and the National Research Council's most recent view on natural attenuation;
- How the Natural Attenuation Guidance is organized (three parts: Written Guidance; Analysis Tool Package-MS Excel Workbooks; User's Operational Manual);
- What the Natural Attenuation Guidance provides;
- Threshold criteria/requirements for evaluating the feasibility and performance of cleanup action alternatives that use Natural attenuation as a cleanup action component;
- How the statistics have integrated with the uncertainty on the prediction of plume behavior to take into account the variability resulting from sampling and analysis
- The format of each threshold requirement: issue/criteria; action/decision; evaluations methods recommended to use;
- A sample table and diagram for minimum/recommended decision making monitoring networks;
- Six calculation modules: functions and goals.

The following is a summary of questions posed by the Board during the presentation and Ecology's responses:

Dr. Landau wondered whether Ecology would allow site owners to use other models, tools or methods that are not listed in the Written Guidance and Evaluation Tool packages to evaluate the Natural attenuation processes.

> Hun Seak Park responded that, yes, site owners may use any Ecology pre-approved tool or models to evaluate the Natural attenuation processes as long as the proposed methods and its evaluation results satisfy expectations set forth in WAC 173-340-370(7) MTCA regulation. Hun Seak added that, in fact, Section 3.5 of the written guidance explains the condition of validity and sensitivity of the proposed data evaluation methods. Also Ecology actually encourages the PLP to use new and innovative data evaluations methods.

Dr. Landau wondered whether Ecology developed (is developing or will develop) any separate written guidance or policy on establishing a reasonable restoration time for a site other than vague rule language in MTCA rule. He was also curious whether Ecology is proposing a default/acceptable restoration time frame under Natural attenuation as a cleanup action. And, if so, what it is based on. He also wondered how natural attenuation as a cleanup action can be selected. What are the major parameters to be considered for the selection of final cleanup actions?

> Michael Feldcamp responded that there is not (nor is one planned) a separate policy on the restoration time other than rule language in WAC

173-340-360(4). He noted that criteria to determine the reasonableness of restoration time does not depend upon the type of remedy chosen, it ties-in with all other aspects of general cleanup requirements during exposure time. The cost effectiveness of natural attenuation is very important, but it is only a part of the decision criteria to select natural attenuation as a permanent cleanup action. There are many other decision-making factors that one has to consider for the final cleanup action(s) selection. Natural attenuation as a permanent cleanup action is not an exception to this cleanup process.

Hun Seak Park added that there is only one state in the United States that defines a numerically default reasonable remediation restoration time. The state of New Hampshire uses 10 years as a default value for an acceptable reasonable remediation time at sites where Natural attenuation is proposed. This state requires a rational argument for modification of the default restoration time. Hun Seak Park stated that MTCA does not provide any legal authority for Ecology to establish a numerical default restoration time required at a site where Natural attenuation is chosen as a cleanup action. He also noted that for the best benefit of site owners, the guidance contains the detailed descriptive criteria for comparative analysis of cleanup action alternatives to determine the reasonableness of the best-estimated/calculated site restoration time instead of providing the numerically acceptable restoration time.

Drs. Duncan and Norman asked the following multiple questions:

Who is the major target audience to use the guidance? What types of contaminants is the guidance dealing with? Do petroleum products produce any further daughter break-down products or ancillary products that site owners have to worry about down on the road, just like chlorinated solvents? Dr. Duncan stated that dissolved oxygen is playing a very minor role to degrade the organic chemicals in groundwater. Is there other geochemistry one needs to look at in sites? How to combine a geochemical indicator in terms of degradation capability? Can this guidance be used for chlorinated solvents at all?

Hun Seak Park responded: The guidance is dealing mainly with petroleum contaminants in the groundwater plume. This guidance will be used much more frequently at LUST sites than other types of sites. Threshold requirements addressed in the guidance can be still applicable for chlorinated solvents-contaminated sites. Also basic principles and data analysis tools for parent chemicals of chlorinated solvents can still be used. In general, unlike chlorinated solvents, petroleum contaminants do not generate any by-product (daughter) chemicals of concern that one has to keep monitoring during later stage of cleanup. That's a generally accepted and known fact in industry and academia. In fact, the dissolved oxygen is relatively smaller (around 10% more or less) part of electron

accepters among other geochemical indicators that contribute to degrade the petroleum contaminants. Oxygen dissolved in groundwater is very limited and difficult to be replenished by itself due to limitation of oxygen transfer between atmospheric air and groundwater. Although major contributors to the degradation are sulfates and methane, the dissolved oxygen content is a very important indicator to inform the condition of red-ox potential.

Dr. Landau noted that there is one exception at a site where the level of groundwater fluctuates frequently, more atmospheric oxygen can easily be dawn into ground and transferred into the groundwater so that dissolved oxygen can be replenished directly by the atmospheric air. Hun Seak Park concurred with Dr. Landau's statement.

Drs. Norman and Duncan asked: Are there other geochemical indicators considered as proof of destruction of contaminants? What other geochemical indicators need to be evaluated and how?

Hun Seak Park responded: dissolved oxygen is a geochemical indicator that one should keep monitoring. There are more indicators in the guidance that are required to be monitored. Also, the guidance provides not only the recommended monitoring frequency and duration schedule of the geochemical indicators, but also the expected changes in these indicators to show that significant biodegradation is occurring. As a matter of fact, this subject is one of the topics that Ecology wants the Board's advice on.

2. Demonstration session

Hun Seak Park demonstrated briefly all six modules of the Natural attenuation analysis tools contained in Natural Attenuation Guidance. The Board asked questions and Hun Seak Park responded, below:

Dr. Duncan wondered what decision criteria (@ Module #1) are used in the evaluation tool packages to define the status of well concentration.

Hun Seak Park responded that confidence level is used as a decision criterion to define the plume status. Detailed calculation procedure is described in the written Guidance and User's Operational Manual.

Dr. Norman asked: What is the difference between Module 5 and 6? What are functions and goals of each module?

Hun Seak Park responded: Both modules stem from the original Domenico's 3-D analytical groundwater transport model. Module 5 is 1-D solution for steady state form of Domenico model so that this module is not able to predict the concentration as a function of time, but is easily

able to estimate the biodegradation rate constants. Module 5 is also able to estimate the rate of biodegradation contributed to the overall bulk attenuation rate. Module 6 is a 2-D full Domenico model to predict the groundwater concentration as a function of time and location of a well. Module 6 requires far more input parameters such as the amount of source mass, than for Module 5. Module 6 involves more rigorous iteration techniques to calibrate the best-fitting biodegradation rate constants against 2-D field groundwater data, and then it estimates the restoration time to achieve cleanup standards at the point of compliance specified. Module 6 is modified from U.S. EPA's public domain BIOSCREEN MODEL.

Dr. Duncan asked: Are the models (or modules) of analysis tool packages actually able to predict the groundwater concentration? How is the ground water concentration related to the soil concentration? Does the module use 4-phase type of partitioning equilibrium model to predict groundwater concentration?

Hun Seak Park responded: Yes, each model has a certain degree of capability to predict groundwater concentration on the basis of certain assumptions. No doubt about it, more data, better model, higher accuracy in prediction. Rather than estimating the groundwater concentration in the source zone with a 4-phase partitioning equilibrium model, true field measurement is being used as a model input parameter. Rather, the mass amount of contaminants to contribute into the groundwater plume (mass loading/dissolution rate) is incorporated in the model so that declining source groundwater concentration is estimated. Soil concentration can be used to calculate the total source mass, but there is no direct relationship between soil concentration and groundwater concentration in the model.

Dr. Landau asked: What is Ecology going to do with altered geochemistry during Natural attenuation process after achieving the cleanup standards for contaminants?

Hun Seak Park responded: Ecology is well aware that the groundwater quality should not only meet cleanup levels, but also the geochemistry (Iron, Manganese, etc) should be returned to natural (original) conditions so that groundwater is available for a beneficial use. The guidance emphasizes the importance of natural geochemistry condition as a part of closure conditions.

Dr. Norman asked: Is the 85% confidence level used on the slope of log-linear regression and non-parametric analysis appropriate? Where does it come from? Is the 85% confidence level for non-parametric statistics compatible with 85% confidence level for parametric statistics?

Hun Seak Park responded: 85% confidence interval is a policy choice and originally came from the state of Wisconsin which uses two fixed criteria (80% and 90%) for this purpose. Raising the level of confidence means that a monitoring groundwater dataset given would be classified more easily into the status of either undetermined or stable due to scatter in the data set. At a site, a more stringent confidence level may be more appropriate, depending on the level of acceptable health risk.

Hun Seak Park noted: Generally speaking, the 85% confidence level for non-parametric statistics is not compatible with the 85% confidence level for parametric statistics. These are two different methods to evaluate the status of plume. There is no way one can define the equivalency between non-parametric and parametric statistical methods.

3. Closing

Hun Seak Park noted that Ecology is currently soliciting written comments from regional staff (due June 26). Ecology would like to share the contents with the Board during the September meeting. He also said he would be willing to personally visit any SAB member who is interested in hearing more from him during the review period. At last, Hun Seak Park requested the Board's advice on the following technical aspects of the guidance:

(1) The guidance sets forth the following threshold criteria for determining the feasibility of natural attenuation as part of a cleanup action.

- Section 3.5.1: Is natural attenuation currently able to reduce contaminant concentrations?
- Section 3.5.2: Is the reduction of contaminant mass occurring?
- Section 3.5.3: Is natural attenuation able to achieve cleanup standards within a reasonable restoration time frame?
- Section 3.5.4: Does on-site contamination pose an unacceptable threat to receptors during the restoration time frame?
- Section 3.5.5: Is source control conducted to the maximum extent practicable so that natural attenuation, either alone or in conjunction with other cleanup action alternatives, can be determined to be feasible?

These criteria are based on the minimum requirements for cleanup actions set forth in WAC 173-340-360 and the expectations set forth in WAC 173-340-370(7). For each of those criteria, the guidance sets forth recommended methods for evaluating and determining compliance with the criterion. Are those methods within the range of scientific defensibility?

(2) Are there other evaluation methods that are more reflective of current scientific understanding that Ecology should consider when evaluating the feasibility of Natural attenuation as a cleanup action alternative?

(3) Is the investigative monitoring plan (Section 3.4.2) for evaluating the feasibility of Natural attenuation within the range of scientific defensibility?

(4) Is the long-term performance monitoring plan (Section 3.6.1) to evaluate the performance of the Natural attenuation process within the range of scientific defensibility?

Public Comment:

Greg Wingard expressed concern about arsenic in soils. He noted that he had made a public disclosure request for Method A related information and that, at one time, consideration had been given to reducing the Method A arsenic value from 20 mg/kg to 7 mg/kg. He is concerned that the number may change as Ecology looks for other ways to address area-wide soil contamination concerns and the Ecology should keep in mind that children are the most sensitive population when discussing a change in risk over wide geographic areas. He asks that Ecology weigh economic considerations carefully against the risk to sensitive individuals.

Summary Approved by the SAB at the November 9th, 2005 meeting